In one embodiment, a one-way friction element is implemented by means of a one-way clutch mechanism. In a ski simulator, the user stands in simulated skis or sliders which engage the clutch when a force is exerted in a rearward direction. The clutch drives a flywheel or other controllable momentum device whose speed is regulated as described below. When the leading leg is pushed forward, a one-way braking engagement element is engaged to simulate the resistance a ski would encounter sliding forward through the snow. In one embodiment, this one-way brake is tied to the one-way clutch such that forward resistance is only encountered relative to the moving flywheel and not the frame of the machine, e.g., by applying a brake pad against the one-way clutch with the brake mounted to and rotating with the flywheel shaft. Preferably the one-way brake is made adjustable so as to simulate the varying snow conditions encountered while cross-country skiing. This method enables the machine to have virtually no external resistance, thereby allowing for an adjustable balance between leading leg and trailing leg which closely simulates that found in natural cross-country skiing exercise. In one embodiment, the ski device can be used without the need for an abdominal support pad and ski exercise can be performed in the absence of contact of the user with a fixed pad.

In one embodiment, the arms operate or grasp ropes, levers or the like which are coupled to preferably independent one-way clutch mechanisms so as to be independent in a bilateral fashion. In one embodiment, two independent ropes are wrapped around a one-way clutch coupled directly to the drive mechanism for the legs such as the flywheel shaft described above. The pulley system can be used to adjust the height at which the rope ends are positioned for grasping by the user in order to appropriately simulate cross-country ski poling. By coupling the arm-exercise devices to the same device used for leg motion resistance, the user encounters kinetic or dynamic resistance such that, at the start of each arm stroke, a moving resistance is encountered (i.e., the flywheel is already in motion) and there is no need to, e.g. overcome a coefficient of static friction. Further, by using both the legs and the arms to drive the same resistance mechanism, arm motion and leg motion are related such that more aggressive arm effort permits less aggressive leg exertion while maintaining a given level of effort.

In one embodiment, flywheel speed is regulated by a friction strap whose tightness or pressure against the flywheel changes depending on the position of the user with respect to the stationary exercise device. For example, in one embodiment, one end of the strap is coupled, e.g., via a line, to the user (such as being clipped to the user's clothing). As the user moves forward, pressure is released from the friction band until the flywheel begins spinning. Once the user has reached the desired speed, the system will automatically maintain that speed. If the user slows his or her pace, the user begins to drift back on the machine, resulting in pulling on the line and tightening the friction band, thus slowing the flywheel speed. As the user speeds up his or her pace, he or she moves forward on the machine, decreasing pressure on the friction band, and thus increasing the flywheel speed. Devices other than a cord and clothing clip can be used for determining the position of the user with respect to the stationary exercise machine, such as a sonar device. In another embodiment, a differential gear device or a

differential motion pulley system adjusts a resistance mechanism (such as by tightening a friction belt on a flywheel) if the user's differential motion (i.e., average forward or backward ski motion) indicates the user is moving forward or rearward with respect to the machine. Thus, the user need not have any physical attachment via a cord or otherwise to the machine. Rather, the machine will sense whether the left/right alternating motion of the skis is resulting in a differential between forward and back motions such that the user is, on average, moving forward or backward with respect to the machine.

Rather than driving the flywheel only from the muscle power of the user, the flywheel may be driven by an electric motor, e.g., to overcome internal friction of the machine. The speed of the motor driving the flywheel is varied depending on the position of the user with respect to the machine (since, e.g., as described above, the machine will automatically adjust to the user's level of effort, as reflected by the user's position on the machine).

In one embodiment, hand grips are mounted on rails coupled to a resistance mechanism which can be used as an alternative to or in addition to the upper body resistance mechanism described above, e.g., to simulate stair climbing with banisters to provide the user, particularly an inexperienced user, with support or stability particularly when the device is used in an inclined configuration.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 depicts a side view of an apparatus according to one embodiment of the present invention;

Fig. 2 is a top plan view (partial) of the apparatus of Fig. 1;

Fig. 3 is a top plan view similar to the view of Fig. 2 but showing a first alternate speed control mechanism;

Fig. 4 is a top plan view similar to the view of Fig. 2 but showing a second alternate speed control mechanism;

Fig. 5 is a side elevational view of an exercise apparatus according to an embodiment of the present invention;

Fig. 5A is a side elevational view of the device of Fig 5, but showing the device configured for increased inclination and with the arm rails extended;

Fig. 6 is a partial exploded perspective view of a footcar and conveyor belt according to an embodiment of the present invention;

Fig. 7 is a top plan view, with upright frame elements removed, of an exercise device according to an embodiment of the present invention;

Fig. 8 is a rear elevational view of an exercise device according to an embodiment of the present invention;

Fig. 9 is a perspective view of an exercise device according to an embodiment of the present invention;

Fig. 10 is a flowchart depicting a procedure for speed control of an exercise device according to an embodiment of the present invention; and

Figs. 11 and 12 are side and partial top views illustrating an exercise device according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As seen in Fig. 1, according to one embodiment, an exercise device includes a lower frame member 23 supported by front and rear frame supports 12, 24. The frame members, support members and the like can be made of a number of materials, including metal, such as steel or aluminum, plastic, fiberglass, wood, reinforced and/or composite materials, ceramics and the like. Preferably the frame supports 12, 24 are coupled to the lower frame such that the lower frame can be inclined 142 at various angles. For example, the incline of the machine can be adjusted by providing front supports 12 with various adjustment mechanisms such as a rack-and-pinion adjustment, hole-and-pin adjustment, ratchet adjustment, and the like. The machine can be operated at an inclination 142 within any of a range of angles, such as between about 0° and 45° (or more) to the horizontal 143, preferably between about 2° and about 30°. Preferably, in the embodiment of Fig. 1, at least some forward and upward inclination 142 is provided during use, e.g., sufficient to overcome internal friction of the device so as to position the user towards the rearmost position 136 while the user is not exercising.

Coupled to the frame on the left side thereof are front and rear idler wheels 9, 25, supporting a simulated ski 22 bearing a ski-type foot support 21, preferably having both toe and heel cups to permit the user to slide the simulated ski both in a forward direction and in a rearward direction against resistance, as described more fully below. The ski 22 can be made of a number of materials, including wood, fiberglass, metal, ceramic, resin, reinforced or composite materials. Preferably the ski 22 can be translated in a forward 112 or rear 114 direction while supported by idler wheels 9, 25. If desired, additional idler wheels can be provided and/or additional supports such as a low-friction support plate or rail, or a belt, cable, chain, or other device running between idler wheels 9, 25 can be used.

In the depicted embodiment, the ski 22 is coupled to a roller 116 such that translation of the ski 22 in a forward direction 112 rotates the roller 116 in a first direction 118, and translation of the ski 22 in the opposite direction 114 rotates roller 116 in the opposite direction 122. Coupling to achieve such driven rotation of the roller 116 can be achieved in a number of fashions. For example, the roller's exterior cylindrical surface 124 and the bottom surface 126 of the ski 22 may be provided with high friction coatings. Teeth may be provided on the surfaces of the ski 22 and the roller 116 to drive the roller in a rack-and-pinion-like fashion. Ski 22 may be